Apprenticeship and Industry Training

Crane and Hoisting Equipment Operator - Tower Crane

Apprenticeship Course Outline

34-2-14 (2014)

Alberta

Apprenticeship and Industry Training

ALBERTA INNOVATION AND ADVANCED EDUCATION

Crane and hoisting equipment operator tower crane: apprenticeship course outline

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Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding an employer. Employers hire apprentices, pay their wages and provide on-the-job training and work experience. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journeyperson or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution – usually a college or technical institute.

To become certified journeypersons, apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board on the recommendation of Crane and Hoisting Equipment Operator - Tower Crane Provincial Apprenticeship Committee.

The graduate of the Crane and Hoisting Equipment Operator - Tower Crane apprenticeship program is a certified journeyperson who will be able to:

- responsibly do all work tasks expected of a journeyperson
- correctly use and care for tools and materials which are required to carry out the normal service and maintenance of the machines of the industry
- operate and describe functions of the major and minor components of boom trucks
- recognize and identify malfunctions and the proper procedures related thereto
- recognize and evaluate conditions which are potentially hazardous to safe machine operation
- interpret and apply load chart and related documentation
- work in conjunction and communicate with other trades, employers and customers
- interpret and apply visual and audio communication
- perform assigned tasks in accordance with quality and production standards required by industry

Apprenticeship and Industry Training System

Industry-Driven

Alberta's apprenticeship and industry training system is an industry-driven system that ensures a highly skilled, internationally competitive workforce in more than 50 designated trades and occupations. This workforce supports the economic progress of Alberta and its competitive role in the global market. Industry (employers and employees) establishes training and certification standards and provides direction to the system through an industry committee network and the Alberta Apprenticeship and Industry Training Board. The Alberta government provides the legislative framework and administrative support for the apprenticeship and industry training system.

Alberta Apprenticeship and Industry Training Board

The Alberta Apprenticeship and Industry Training Board provides a leadership role in developing Alberta's highly skilled and trained workforce. The board's primary responsibility is to establish the standards and requirements for training and certification in programs under the Apprenticeship and Industry Training Act. The board also provides advice to the Minister of Advanced Education on the needs of Alberta's labour market for skilled and trained workers, and the designation of trades and occupations.

The thirteen-member board consists of a chair, eight members representing trades and four members representing other industries. There are equal numbers of employer and employee representatives.

Industry Committee Network

Alberta's apprenticeship and industry training system relies on a network of industry committees, including local and provincial apprenticeship committees in the designated trades, and occupational committees in the designated occupations. The network also includes other committees such as provisional committees that are established before the designation of a new trade or occupation comes into effect. All trade committees are composed of equal numbers of employer and employee representatives. The industry committee network is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the board can set up a local apprenticeship committee. The board appoints equal numbers of employee and employer representatives for terms of up to three years. The committee appoints a member as presiding officer. Local apprenticeship committees:

- monitor apprenticeship programs and the progress of apprentices in their trade, at the local level
- make recommendations to their trade's provincial apprenticeship committee (PAC) about apprenticeship and certification in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- make recommendations to the board about the appointment of members to their trade's PAC
- help settle certain kinds of disagreements between apprentices and their employers
- carry out functions assigned by their trade's PAC or the board

Provincial Apprenticeship Committees (PAC)

The board establishes a provincial apprenticeship committee for each trade. It appoints an equal number of employer and employee representatives, and, on the PAC's recommendation, a presiding officer - each for a maximum of two terms of up to three years. Most PACs have nine members but can have as many as twenty-one. Provincial apprenticeship committees:

- Make recommendations to the board about:
    - standards and requirements for training and certification in their trade
    - courses and examinations in their trade
    - apprenticeship and certification
    - designation of trades and occupations
    - regulations and orders under the Apprenticeship and Industry Training Act
- monitor the activities of local apprenticeship committees in their trade
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- consult with other committees under the Apprenticeship and Industry Training Act about apprenticeship programs, training and certification and facilitate cooperation between different trades and occupations
- consult with organizations, associations and people who have an interest in their trade and with employers and employees in their trade
- may participate in resolving certain disagreements between employers and employees
- carry out functions assigned by the board

Crane and Hoisting Equipment Operator – Tower Crane PAC Members at the Time of Publication

Mr. B. Mahon	Onoway	Presiding Officer
Mr. G. Alexander	Coalhurst	Employer
Mr. M. Danderfer	Beaumont	Employer
Mr. S. Gibson	Edmonton	Employer
Mr. D. Secord	Spruce Grove	Employer
Mr. D. Grenier	Edmonton	Employee
Mr. R. Titcomb	Edmonton	Employee

Alberta Government

Alberta Advanced Education works with industry, employer and employee organizations and technical training providers to:

- facilitate industry's development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and employers
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

Technical Institutes and Colleges

The technical institutes and colleges are key participants in Alberta's apprenticeship and industry training system. They work with the board, industry committees and Alberta Advanced Education to enhance access and responsiveness to industry needs through the delivery of the technical training component of apprenticeship programs. They develop lesson plans from the course outlines established by industry and provide technical training to apprentices.

Apprenticeship Safety

Safe working procedures and conditions, incident/injury prevention, and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees, apprentices and the public. Therefore, it is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviours that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

Alberta Apprenticeship and Industry Training Board Safety Policy

The Alberta Apprenticeship and Industry Training Board (board) fully supports safe learning and working environments and emphasizes the importance of safety awareness and education throughout apprenticeship training- in both on-the- job training and technical training. The board also recognizes that safety awareness and education begins on the first day of on-the-job training and thereby is the initial and ongoing responsibility of the employer and the apprentice as required under workplace health and safety training. However the board encourages that safe workplace behaviour is modeled not only during on-the-job training but also during all aspects of technical training, in particular, shop or lab instruction. Therefore the board recognizes that safety awareness and training in apprenticeship technical training reinforces, but does not replace, employer safety training that is required under workplace health and safety legislation.

The board has established a policy with respect to safety awareness and training:

> **The board promotes and supports safe workplaces, which embody a culture of safety for all apprentices, employers and employees. Employer required safety training is the responsibility of the employer and the apprentice, as required under legislation other than the *Apprenticeship and Industry Training Act.***

The board's complete document on its 'Apprenticeship Safety Training Policy' is available at www.tradesecrets.alberta.ca ; access the website and conduct a search for 'safety training policy'.

Implementation of the policy includes three common safety learning outcomes and objectives for all trade course outlines. These common learning outcomes ensure that each course outline utilizes common language consistent with workplace health and safety terminology. Under the title of 'Standard Workplace Safety', this first section of each trade course outline enables the delivery of generic safety training; technical training providers will provide trade specific examples related to the content delivery of course outline safety training.

Occupational Health and Safety

A tradesperson is often exposed to more hazards than any other person in the work force and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Occupational Health and Safety (a division of Alberta Human Services) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at www.humanservices.alberta.ca

Technical Training

Apprenticeship technical training is delivered by the technical institutes and many colleges in the public post-secondary system throughout Alberta. The colleges and institutes are committed to delivering the technical training component of Alberta apprenticeship programs in a safe, efficient and effective manner. All training providers place great emphasis on safe technical practices that complement safe workplace practices and help to develop a skilled, safe workforce.

The following institutions deliver Crane and Hoisting Equipment Operator - Tower Crane apprenticeship technical training:

Keyano College

Procedures for Recommending Revisions to the Course Outline

Advanced Education has prepared this course outline in partnership with the Crane and Hoisting Equipment Operator - Tower Crane Provincial Apprenticeship Committee.

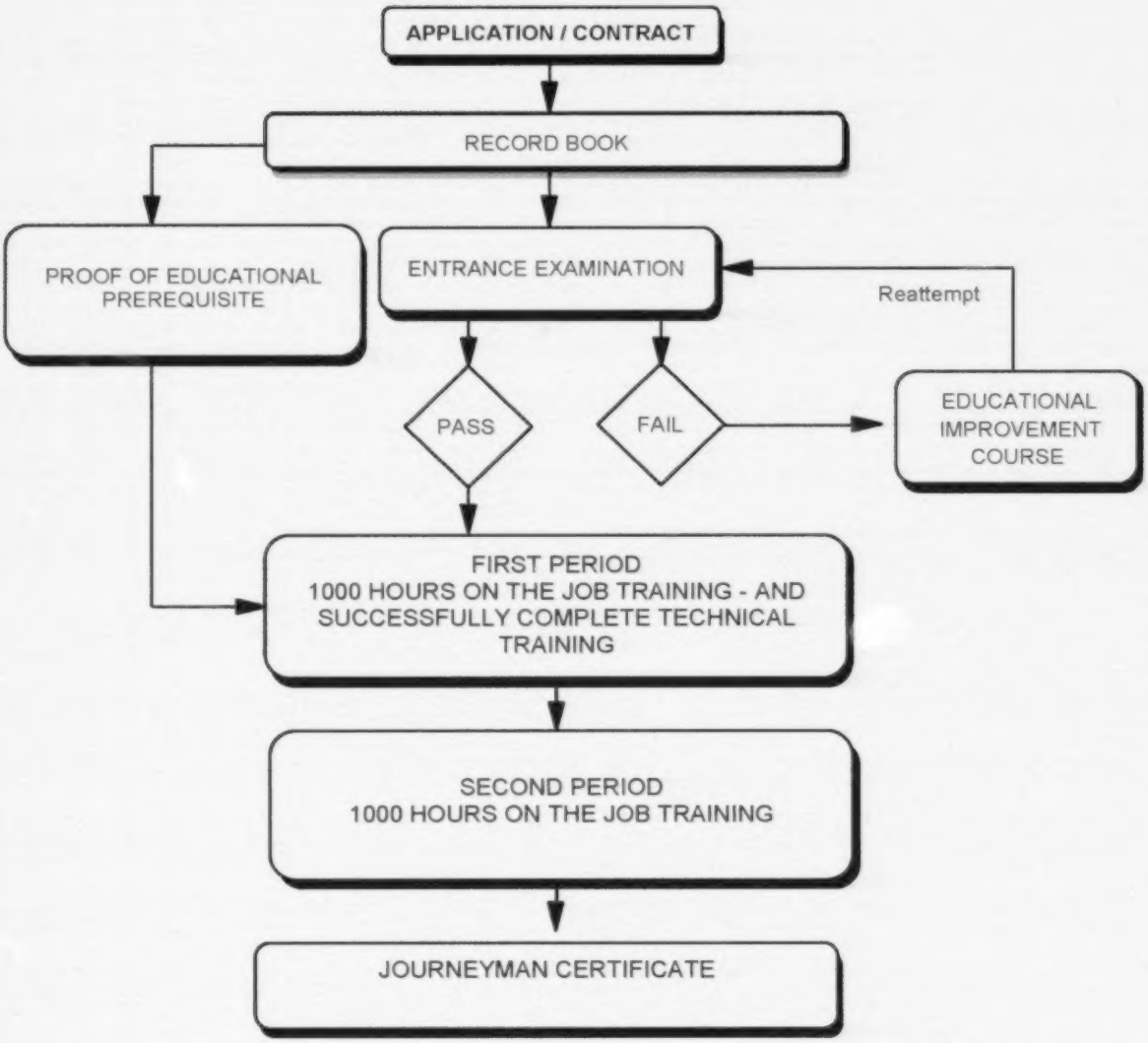
This course outline was approved on March 25, 2011 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

Crane and Hoisting Equipment Operator - Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
Advanced Education
10th floor, Commerce Place
10155 102 Street NW
Edmonton AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used. Recommendations for change will be placed on the agenda for regular meetings of the Crane and Hoisting Equipment Operator - Tower Crane Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification



Crane and Hoisting Equipment Operator - Tower Crane Training Profile
FIRST PERIOD
(6 Weeks - 30 Hours per Week – Total of 180 Hours)

SECTION ONE	A	B	C
STANDARD WORKPLACE SAFETY **10 HOURS**	Safety Legislation, Regulations & Industry Policy in the Trades 4 Hours	Climbing, Lifting, Rigging and Hosting 3 Hours	Hazardous Materials & Fire Protection 3 Hours
SECTION TWO	A	B	C
TOWER CRANE THEORY AND PRACTICAL **80 HOURS**	Tower Cranes and Components and Terms 7 Hours	Basic Math Concepts 3 Hours	Trade Math 3 Hours
	D	E	F
	Common Tower Crane Maintenance 7 Hours	Basic Hydraulic Systems 6 Hours	Basic Electrical Systems 4 Hours
	G	H	I
	Tower Crane Documentation 2 Hours	Pre-Operational Inspection 10 Hours	Leaving Crane Unattended 2 Hours
	J	K	
	Crane Operation 28 Hours	Crane Leverage 8 Hours	
SECTION THREE	A	B	C
LOAD CHARTS **34 HOURS**	Basic Terms and Conditions 6 Hours	Configuration of Crane 24 Hours	Pre Lift Planning and Load Chart Calculations 4 Hours
SECTION FOUR	A	B	C
OPERATING PROCEDURES **35 HOURS**	Job Condition Assessment 14 Hours	Operation of Crane 12 Hours	Crane Set Up 5 Hours
	D	E	
	Multi-Crane Sites 2 Hours	New Technology 2 Hours	
SECTION FIVE	A		
RIGGING PRACTICES AND PROCEDURES **15 HOURS**	Rigging Practices 15 Hours		
SECTION SIX	A	B	C
ALBERTA'S INDUSTRY NETWORK AND WORKPLACE COACHING SKILLS **6 HOURS**	Workplace Coaching Skills 2 Hours	Alberta's Industry Network 2 Hours	Interprovincial Standards Red Seal Program 2 Hours

NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training.

FIRST PERIOD TECHNICAL TRAINING
CRANE AND HOISTING EQUIPMENT OPERATOR - TOWER CRANE TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: .....STANDARD WORKPLACE SAFETY.....10 HOURS

A. Safety Legislation, Regulations & Industry Policy in the Trades .....4 Hours

Outcome: ***Describe legislation, regulations and practices intended to ensure a safe work place in this trade.***

1. Apply the Occupational Health and Safety Act, Regulation and Code.
2. Explain the role of the employer and employee in regard to Occupational Health and Safety (OH&S) regulations, Worksite Hazardous Materials Information Systems (WHMIS), fire regulations, Workers Compensation Board regulations, and related advisory bodies and agencies.
3. Explain industry practices for hazard assessment and control procedures.
4. Describe the responsibilities of workers and employers to apply emergency procedures.
5. Describe positive tradesperson attitudes with respect to housekeeping, personal protective equipment and emergency procedures.
6. Describe the roles and responsibilities of employers and employees with respect to the selection and use of personal protective equipment (PPE).
7. Select, use and maintain appropriate PPE for worksite applications.

B. Climbing, Lifting, Rigging and Hoisting ..... 3 Hours

Outcome: ***Describe the use of personal protective equipment (PPE) and safe practices for climbing, lifting, rigging and hoisting in this trade.***

1. Select, use and maintain specialized PPE for climbing, lifting and load moving equipment.
2. Describe manual lifting procedures using correct body mechanics.
3. Describe rigging hardware and the safety factor associated with each item.
4. Select the correct equipment for rigging typical loads.
5. Describe hoisting and load moving procedures.

C. Hazardous Materials & Fire Protection..... 3 Hours

Outcome: ***Describe the safety practices for hazardous materials and fire protection in this trade.***

1. Describe the roles, responsibilities features and practices related to the workplace hazardous materials information system (WHMIS) program.
2. Describe the three key elements of WHMIS.
3. Describe handling, storing and transporting procedures when dealing with hazardous material.
4. Describe safe venting procedures when working with hazardous materials.
5. Describe fire hazards, classes, procedures and equipment related to fire protection.

SECTION TWO: ..... TOWER CRANE THEORY AND PRACTICAL ..... 80 HOURS

A. Tower Cranes and Components and Terms ..... 7 Hours

Outcome: Demonstrate knowledge of tower crane types and components.

1. Identify common structural and operational characteristics for different types of tower cranes.
2. Describe the function of a counter jib or ballast system.
3. Describe the function of a jib and counterweights.
4. Describe the components and functions of a main hoist system.
5. Describe the components and functions of a trolley system.
6. Describe the components and functions of a mast.
7. Describe the components and functions of outriggers for tower cranes and self-erect tower cranes.
8. Describe the types of swing configurations and components.
9. Describe the components used for the base support section.
10. Describe the functions of a control system.
11. Describe the functions of load moment devices, limit switches and lockouts.

B. Basic Math Concepts ..... 3 Hours

Outcome: Solve basic math problems in the metric and imperial systems of measurement.

1. Describe the imperial and metric (SI) measurement systems.
2. Use a calculator to solve basic math problems.
3. Convert fractions to decimals and vice versa.
4. Convert measurements between imperial and metric values.

C. Trade Math ..... 3 Hours

Outcome: Solve trade-related mathematical problems.

1. Calculate the area, volume and mass of geometric shapes.
2. Calculate line and load calculations using industry-accepted formulas.
3. Calculate working load limits for slings.

D. Common Tower Crane Maintenance ..... 7 Hours

Outcome: Describe maintenance procedures for tower cranes.

1. Explain the limits of tower crane maintenance.
2. Inspect and maintain tower crane equipment as specified by the manufacturer.
3. Select the appropriate lubricant for the required application.

E. Basic Hydraulic Systems ..... 6 Hours

Outcome: Explain operation of basic hydraulic systems.

1. Identify components and their function in a basic hydraulic system.
2. Describe the basic principles of operation of a hydraulic system.

3. Describe the transmission of power through hydraulic power.
4. Determine the effects of cold weather and/or contaminants in the system.

F. Basic Electrical Systems ..... 4 Hours

Outcome: Explain the electrical system on a tower crane.

1. Identify the major circuits of a tower crane electrical system.
2. List the electrical safety components of a tower crane electrical system.
3. Explain how the individual components function as a operational system.

G. Tower Crane Documentation ..... 2 Hours

Outcome: Use documentation related to the operation of a tower crane.

1. Identify legislative documents related to tower crane operation.
2. Describe the use of the operators log book for inspection records.
3. Describe the use of a tower cranes log book for inspection and service records.
4. Use original equipment manufacturers manuals to explain the operation of tower cranes.

H. Pre-Operational Inspection ..... 10 Hours

Outcome: Perform a daily pre-operational inspection.

1. Inspect mechanical, structural, and electrical systems and support components.
2. Record inspection results in the logbook.
3. Describe procedures for reporting defects found during inspections.
4. Test limit switches.
5. Perform load tests.

I. Leaving Crane Unattended ..... 2 Hours

Outcome Secure an unattended tower crane.

1. Demonstrate the procedure for leaving a tower crane unattended to meet industry standards.
2. Explain the differences between leaving a tower crane unattended for an extended period as opposed to a short period.
3. Explain the difference between weather-vaning and securing.
4. Describe job site requirements due to general hazards that may occur while leaving a tower crane unattended.

J. Crane Operation ..... 28 Hours

Outcome: Operate a tower crane.

1. Identify the key persons and their respective responsibilities involved in a lift.
2. Describe applicable legislation and codes affecting tower crane operation.
3. Describe the conditions that cause tower crane overloading.
4. Describe how to protect site personnel in the vicinity of the lift.
5. Explain the necessary precautions required when operating a tower crane near high voltage equipment.
6. Describe the procedures to follow if electrical contact is made with high voltage equipment.

7. Demonstrate communication during a lift.
8. Describe operating conditions that may affect tower crane capacity.
9. Operate a tower crane through all available motions and varying load conditions.

K. Crane Leverage ..... 8 Hours

Outcome: Describe principles of leverage.

1. Explain terms used in relation to the principles of leverage.
2. Identify factors that affect the centre of gravity of a tower crane and a load.
3. Identify the location of the center of gravity during rotation of the jib.
4. Define fulcrum and how it applies to crane operation.
5. Describe the basic mechanical advantage of leverage used in hoisting.
6. Describe the principles of load leverage.
7. Describe forward stability rating in percentage of tipping.
8. Describe backward stability for a crane.
9. Describe static load vs. dynamic load.
10. Describe the effect of winch diameter multi-layer wire rope, and line speed vs. torque.
11. Determine sheave loads.
12. Determine the WLL of rope vs. line pull.
13. Describe the effect of sheave friction during a lift.
14. Describe the mechanical advantage of reeving.

SECTION THREE: ..... LOAD CHARTS ..... 34 HOURS

A. Basic Terms and Conditions ..... 6 Hours

Outcome: Interpret load charts.

1. Describe the factors affecting capacity of a tower crane.
2. Explain the difference between gross capacity and net capacity.
3. Explain the difference between gross load and net load.

B. Configuration of Crane ..... 24 Hours

Outcome: Demonstrate planning and configuring the crane.

1. Describe required load radius.
2. Interpret load radius using chart listings.
3. Determine the parts of line required.
4. Describe mast, jib and counter jib configurations.

C. Pre Lift Planning and Load Chart Calculations ..... 4 Hours

Outcome: Perform load chart calculations.

1. Describe the factors that affect crane capacity with respect to operating conditions and crane configurations.
2. Perform load chart calculations by interpreting crane capacity charts.

SECTION FOUR: ..... OPERATING PROCEDURES ..... 35 HOURS

A. Job Condition Assessment ..... 14 Hours

Outcome: ***Demonstrate knowledge and skill in planning a lift.***

1. Interpret lift study drawings.
2. Assess the crane site to identify hazards.
3. Determine the crane type for the planned tasks and job scope in accordance with manufacturers' specifications and legislation.
4. Determine the set up location required for the planned tasks and job scope, in accordance with manufacturers' specifications and legislation.
5. Locate the crane on firm level ground as per manufacturer's specifications.
6. Explain outrigger loadings.
7. Describe necessary precautions when operating cranes in adverse weather conditions, in accordance with manufacturers' specifications and legislation.

B. Operating Procedures ..... 12 Hours

Outcome: ***Demonstrate operation of a crane.***

1. Determine weight of loads using available means.
2. Demonstrate the use of a site assessment to perform a set-up for any tower crane Determine the centre of gravity of the load.
3. Demonstrate use of trolley position indicators.
4. Identify reasons for slack rope on drums and uneven spooling.
5. Document procedures and responsibilities of individuals to protect personnel during operations.
6. Describe rigging procedures when lifting a personnel basket.
7. Describe the effect on the jib when the load contacts a crane.
8. Describe the effect of the jib touching or resting on a structure.
9. Describe jib design including compression vs. bending.
10. Demonstrate the use of hoisting hand and radio signals.
11. Demonstrate correct outrigger use.
12. Demonstrate use of a levelling device to ensure crane is level.

C. Crane Set Up ..... 5 Hours

Outcome: ***Describe the set-up of a tower crane.***

1. Describe proper set up of tower cranes including the crane base, swing clearance and power supply.
2. Describe the bolting procedures and safety precautions to erect and dismantle a crane.
3. Describe considerations for selecting type and configuration of tower crane.
4. Determine maximum radii at which given weights may be safely handled.

D. Multi-Crane Sites.....2 Hours

Outcome: ***Explain factors affecting multi-crane conditions.***

1. Discuss hazards on multi-crane sites.
2. Describe communication between operators during multi-crane lifts.
3. Discuss legislative requirements during a multiple crane lift.

E. New Technology .....2 Hours

Outcome: ***Identify new tower crane technology.***

1. Describe new technology.
2. Describe the use of latest crane technology.

SECTION FIVE:.....RIGGING PRACTICES AND PROCEDURES .....15 HOURS

A. Rigging Practices.....15 Hours

Outcome: ***Demonstrate rigging of a load.***

1. Describe different types of rigging hardware and equipment.
2. Demonstrate the uses of spreader bars and lifting beams.
3. Demonstrate the use of taglines to control the load.
4. Describe how loading is equalized by using devices such as turnbuckles, chain hoists and safety slings.
5. Describe procedures for reeving tower cranes.
6. Demonstrate how the relationship between sling diameter and load attachment can affect sling capacity.
7. Identify the different types and configurations and design factors for various slings.
8. Demonstrate the use of different sling arrangements and sling capacity for various slings.
9. Describe advantages and disadvantages of materials and constructions used in slings.
10. Explain when softeners or protection is required to protect slings.
11. Maintain and inspect rigging hardware.
12. Apply rejection criteria to rigging components.
13. Describe the types and use of wire rope clips.
14. Interpret wire rope manufacturer's ratings to determine the working load limit of wire rope used for hoist lines and slings.
15. Describe the effects of load centre of gravity on sling tension.
16. Describe sheave and drum standards and inspection criteria.
17. Describe wire rope characteristics and their effect on hoisting applications.
18. Describe the causes of wire rope damage and rejection criteria.
19. Identify safety factors for ropes and slings.
20. Demonstrate proper installation procedures for wire rope.

SECTION SIX: ..ALBERTA'S INDUSTRY NETWORK AND WORKPLACE COACHING SKILLS ..... 6 HOURS

A. Workplace Coaching Skills ..... 2 Hours

Outcome: ***Display coaching skills.***

1. Describe coaching skills used for training apprentices.

B. Alberta's Industry Network ..... 2 Hours

Outcome: ***Describe the role of the Alberta and Industry Training Board and the network of industry committees that represent the trades and occupations in Alberta.***

1. Describe Alberta's apprenticeship and industry training system.
2. Describe the roles and responsibilities of the Alberta Apprenticeship and Industry Training Board, government and post-secondary institutions.
3. Describe the roles and responsibilities of the PACs, LACs and occupational committees.

C. Interprovincial Standards Red Seal Program ..... 2 Hours

Outcome: ***Use Red Seal products to challenge an Interprovincial examination.***

1. Identify Red Seal products used to develop Interprovincial examinations.
2. Use Red Seal products to prepare for an Interprovincial examination.

Excellence through training and experience

34-2-14